he made every observation himself, with the assistance of Mrs. Thome and Mr. Schuldt as recorders. It is impossible not to speak in the highest terms of the ability and untiring devotion of Thome in prosecuting and accomplishing this important and valuable contribution to astronomy. He will always occupy an honourable place in the roll of great workers in that science.

In the year 1900 the Paris Astrographic Congress resolved to ask the Cordoba Observatory to take over the photographic zone between the 23rd. and 31st. degrees of south declination, which had been previously assigned to the observatory at La Plata. This was accepted by Thome, and by the beginning of 1902 his observatory was equipped with an astrographic telescope by Gautier and all necessary apparatus; since then the work has been prosecuted with the Director's characteristic energy.

Though no paper by Thome appears in the publications of this Society, he contributed various papers to astronomical journals on comets, variable stars, minor planets, etc.

He died at Cordoba rather suddenly on September 27, 1908.

He was elected a Foreign Associate November 10, 1899.

E. B. K.

Charles Augustus Young was born on December 15, 1834, at Hanover, New Hampshire, U.S.A., a small town chiefly notable as the site of Dartmouth College—one of the older institutions of learning of New England—in which his grandfather and his father successively occupied the Chair of Natural Philosophy, and from which he himself received the degree of Bachelor of Arts in 1853, graduating with distinction.

After four years spent in teaching the classics and in theological studies, he accepted the post of Professor of Mathematics and Natural Philosophy at Western Reserve University in Ohio, which he held for nine years. In 1862 he was for four months captain in one of the many volunteer regiments of the Federal army, returning after service in the Mississippi swamps with impaired health, which was never quite restored.

In 1868 he returned to his own college—Dartmouth—as Professor of Natural Philosophy and Astronomy, and in 1877 he accepted a call to the Professorship of Astronomy at the College of New Jersey (now Princeton University), which he held for twenty-eight years. Retiring in 1905 on account of failing health and strength, he was appointed Professor-Emeritus, but returned to his old home in New Hampshire, where he died, after a short illness, on January 3, 1908.

At the time when Professor Young's scientific career began, the spectroscope was just taking its place as a new and powerful instrument of astrophysical research. In spite of heavy duties as a teacher, he did not content himself with expounding the new discoveries to his students, but engaged actively in solar research.

Observing the total eclipse of 1869 at Burlington, Iowa, he was able to demonstrate for the first time the solar character and

(at least partially) gaseous nature of the corona by his discovery of the green line (λ 5304) in its spectrum, whose wave-length he approximately determined, identifying it with the chromospheric line at λ 5317. The latter, just before totality, is conspicuously bright in the spectrum of the Sun's limb, but fades out in a few seconds after totality begins, when the much fainter coronal line becomes visible. With the low dispersion of even the most powerful instruments of that day the difference in position of the two lines is far from conspicuous, and it is not surprising that it remained unnoticed until the measurements of Lockyer in 1898, confirmed by Campbell in 1899, from independent observations made in the eclipse of 1898. At the eclipse of 1900, Professor Young planned to observe (visually) the fading out of the chromosphere line and the appearance of the coronal, but was defeated by the abnormal faintness of the latter, which (on one limb of the Sun at least) was quite invisible, though the continuous spectrum of the corona was conspicuous.

At the instant when this might have been seen in 1869, Professor Young was looking for a phenomenon of greater importance, predicted on theoretical grounds, which he was the first to observe at the Spanish eclipse of the following year—the "flash spectrum." His own description is: "The very instant the Sun is hidden, through the whole length of the spectrum the red, the green, the violet, the bright lines flash out by hundreds and thousands, almost startlingly; as suddenly as stars from a bursting rocket-head, and as evanescent, for the whole thing is over in two or three seconds."

From this observation he concluded that the bulk of the absorption which produces the Fraunhofer lines originates in a thin stratum, but a few hundred miles in thickness, directly above the photosphere, which he named the "reversing layer." This theory, though for many years a subject of controversy, was conclusively established by the photographs obtained with the prismatic camera in 1898 and at later eclipses—to the great, though very gently expressed, satisfaction of its author.

Probably next in importance in his work are the observations upon the chromospheric lines, which he began at Dartmouth, and continued on an expedition to Wyoming in the summer of 1872—where, in the clear air at an altitude of 8000 feet, he added 100 more to the list of 190 lines previously observed. These observations were continued at Princeton for many years.

His list of these lines give not only their wave-lengths, but their relative frequencies, varying from 100 for lines which are always reversed at the Sun's limb, to 1 or 2 for those which only occasionally so appear, in regions of great disturbance. It is still the principal authority upon the subject.

In the course of his solar observations he met with many remarkable and unusual phenomena—the highest recorded prominences, distortions of spectral lines, indicating radial velocities up to 500 kilometres per second, and the like. Many of his drawings

of prominences have become classic, from their frequent reproduction.

He was the first to photograph a prominence (in 1870)—though with only partial success, owing to the slowness of the wet plates then used; and in 1876 he made the first use of the grating spectroscope in astronomy, determining the Sun's rotation period by means of the displacement of the lines at the opposite limbs. At Princeton he continued his observations with a much more powerful equipment, and in 1883 he discovered that the background of the spectrum of the sun-spot umbra was not uniformly dark, but, under high dispersion, was resolved into extremely numerous and close-packed dark lines—a difficult observation, now known to be of great importance, in the light of the recent identification of many of these "band lines" with those in the spectra of *compounds* whose existence has been claimed as indicating a lower temperature for the spot than for the rest of the disk.

By no means all Professor Young's scientific expeditions have yet been mentioned. He successfully observed both transits of Venus, in 1874 at Pekin, and in 1882 at home in Princeton. Solar eclipses took him to Denver in 1878, to Russia in 1887, and to North Carolina in 1900. At the second of these bad weather prevented all observations, but conditions were excellent at the other two.

First in importance among his publications is his volume *The Sun*, which appeared in 1881, and has gone through several editions —the last, thoroughly revised, dating from 1895—and has been translated into several languages. It is a standard and authoritative work, covering the whole range of solar physics, so far as it then extended, and giving its author's interpretations of difficult points—which have often been remarkably confirmed by later discoveries—and written in the clear and attractive style which characterises all his productions.

As a writer of astronomical text-books he was unsurpassed, and probably no such works are more widely known, in America at least, than his *Elements of Astronomy*; *General Astronomy*; and the later *Manual of Astronomy*, all of which passed through frequent editions, and were carefully kept up to date by their author until the very close of his life. The accuracy and lucidity of his style are here shown at their best, while the extensive range of his knowledge and his sense of proportion make the larger works very useful as books of reference to many who are no longer counted as students of astronomy in the academic sense.

All who have studied under Professor Young agree that he possessed exceptional gifts as a teacher. His undergraduate lectures were amongst the most popular in the university—not because of any oratorical gifts, nor for the too frequent reason that his examinations were supposed to be easy to pass—but because the clear, well-proportioned outline which they gave of the universe was recognised as a "culture course" of the highest value, and no less because of the personality of the lecturer. Few will forget his

genial courtesy, his individual interest in his students, all of whom, in successive classes, well-nigh a hundred in number, he could call by name, and the quaint New England humour which enlivened his sentences—as when, translating literally from the French, he declared "The Earth's atmosphere is the astronomer's black beast"!

But it was to those who had the privilege of advanced study under his direction that his qualities were most manifest. His extensive knowledge of the whole field of astronomy and of kindred sciences—which even those who knew him well found hard to appreciate, because of the modesty which made him disclaim any exceptional learning—his fairness and sound judgment in matters open to doubt or controversy—the patient care with which he would read and criticise a student's manuscript, suggesting one verbal amendment after another, until one was found which satisfied his exacting sense for accuracy and brevity of expression, combined with good English,—these and many other things made association with him a liberal education indeed.

His scientific attainments won him honorary degrees from several institutions and membership in many learned societies—among them the Royal Astronomical Society, which elected him an Associate 1872 November 8. H. N. R.